

U.S. Patent Application Serial No. 09/812,951

REMARKS

Claims 1-15 are pending in this application, of which claims 1-13 and 15 have been amended.

No new claims have been added.

Claims 1-15 stand rejected under 35 USC §103(a) as unpatentable over U.S. Patent 4,387,330 to Zigler (hereinafter "Zigler") in view of U.S. Patent 3,157,809 to Bekey (hereinafter "Bekey").

Applicants respectfully traverse this rejection.

Zigler discloses a single phase alternating current induction type electric motor designed for use in hermetically sealed compressors. A conventional squirrel cage rotor 21 suitably journaled for rotation within a conventional slotted stator core 22 is provided.

The Examiner has cited Bekey for disclosing a rotor 28 and a permanent magnet 12 embedded in the rotor yoke 13.

Bekey discloses only a single permanent magnet 12, in contrast to the present invention, which discloses a plurality of permanent magnets. This plurality of magnets is critical to the present invention for the reasons included in the description on page 10, lines 12-25 of the specification of the instant application, which states that different magnetic poles of the magnets should be arranged next to each other.

Accordingly, claims 1 and 9 have been amended to recite this distinction.

Thus, the 35 USC §103(a) rejection should be withdrawn.

In view of the aforementioned amendments and accompanying remarks, claims 1-15, as amended, are in condition for allowance, which action, at an early date, is requested.

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If, for any reason, it is felt that this application is not now in condition for allowance, the Examiner is requested to contact Applicants undersigned attorney at the telephone number indicated below to arrange for an interview to expedite the disposition of this case.

Attached hereto is a marked-up version of the changes made to the specification, Abstract and claims by the current amendment. The attached page is captioned "Version with markings to show changes made."

In the event that this paper is not timely filed, Applicants respectfully petition for an appropriate extension of time. Please charge any fees for such an extension of time and any other fees which may be due with respect to this paper, to Deposit Account No. 01-2340.

Respectfully Submitted,

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PATENT TRADEMARK OFFICE

Enclosures: Version with markings to show changes made
Substitute Abstract of the Disclosure

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VERSION WITH MARKINGS TO SHOW CHANGES MADE 09/812,951

IN THE ABSTRACT:

Please amend the Abstract as follows:

[There is disclosed a] A sealed motor compressor in which a motor running efficiency is largely enhanced with a single-phase bipolar constitution, an electromotive element is fixed to a sealed container, and [constituted] formed of a stator provided with a stator winding, and a rotor which rotates in the stator, and the rotor is [constituted] formed of a squirrel-cage secondary conductor disposed in a peripheral portion of a rotor yoke, and a permanent magnet is embedded in the rotor yoke.

IN THE SPECIFICATION:

Please amend the specification as follows:

Insert the heading before the line beginning at page 1, line 7 as follows:

1. Field of the Invention

Paragraph beginning at page 1, line 7 has been amended as follows:

The present invention relates to a sealed motor compressor [constituted to contain] containing a compressing element and an electromotive element for driving the compressing element in a sealed container.

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Insert the heading before the paragraph beginning at page 1, line 11 as follows:

2. Description of the Related Art

Paragraph beginning at page 1, line 11 has been amended as follows:

As a conventional electromotive element for driving a sealed motor compressor [constituting] forming a freezing cycle of a refrigerator (freezer), or an air conditioner, an induction motor driven by a single-phase commercial power source, DC brushless motor, and the like have been employed. An electromotive element of the motor is fixed in a sealed container, and the electromotive element is [constituted] formed of a stator comprising a stator winding, and a rotor rotating in the stator. Moreover, the electromotive element supplies a commercial alternating current supply to the stator winding to induce/rotate the rotor.

Paragraph beginning at page 1, line 22 has been amended as follows:

However, the DC brushless motor requires a drive control equipment, and disadvantageously results in a cost increase. Moreover, [since] because a secondary copper loss is theoretically present in the induction motor, running efficiency is limited. Therefore, there has been a desire for further improvement of the running efficiency of the sealed motor compressor driven by the commercial single phase power source without using any control equipment.

Paragraph beginning at page 2, line 9 has been amended as follows:

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The present invention has been developed to solve such related art problem, and an object thereof is to provide a sealed motor compressor whose single-phase bipolar [constitution] construction largely enhances a motor running efficiency.

Paragraph beginning at page 2, line 13 has been amended as follows:

Another object of the present invention is to provide a sealed motor compressor in which an electromotive element with a three-phase bipolar [constitution] construction can be driven with a high efficiency without requiring any drive control equipment.

Paragraph beginning at page 2, line 18 has been amended as follows:

That is to say, according to the present invention, there is provided a sealed motor compressor [constituted to contain] containing a compressing element and an electromotive element for driving the compressing element in a sealed container. The electromotive element is fixed to the sealed container, and [constituted] formed of a stator provided with a stator winding and a rotor which rotates in the stator. The rotor comprises a squirrel-cage secondary conductor disposed in a peripheral portion of a rotor yoke, and a permanent magnet embedded in the rotor yoke.

Paragraph beginning at page 3, line 1 has been amended as follows:

Moreover, for the sealed motor compressor of the present invention, in the above, the electromotive element comprises a single-phase bipolar [constitution] construction.

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Paragraph beginning at page 3, line 13 has been amended as follows:

Moreover, in the sealed motor compressor of the present invention, [in addition to the aforementioned respective inventions,] the squirrel-cage secondary conductor of the rotor comprises a skewed structure.

Paragraph beginning at page 3, line 17 has been amended as follows:

Furthermore, for the sealed motor compressor of the present invention, [in the aforementioned respective inventions,] the permanent magnet is a rare earth magnet.

Paragraph beginning at page 3, line 20 has been amended as follows:

Additionally, for the sealed motor compressor of the present invention, [in the aforementioned respective inventions,] the number of permanent magnets embedded in the rotor yoke is any number selected from the group consisting of two, four, six and eight.

Paragraph beginning at page 3, line 25 has been amended as follows;

Moreover, [in addition to the aforementioned respective inventions,] the sealed motor compressor of the present invention further comprises current-sensitive protection means for detecting a line current.

Paragraph beginning at page 4, line 2 has been amended as follows:

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Furthermore, according to the present invention, there is provided a sealed motor compressor [constituted to contain] containing a compressing element and an electromotive element for driving the compressing element in a sealed container. The electromotive element is driven by a three-phase power source, fixed to the sealed container, and constituted of a stator provided with a stator winding and a permanent magnet embedded type rotor which rotates in the stator. The rotor comprises a squirrel-cage secondary conductor disposed in a peripheral portion of a rotor yoke, and a permanent magnet embedded in the rotor yoke.

Paragraph beginning at page 4, line 16 has been amended as follows:

Furthermore, in the sealed motor compressor of the present invention, [in addition to the aforementioned respective inventions,] the squirrel-cage secondary conductor of the rotor comprises a skewed structure, and a skew pitch is more than 0, and is 1.5 slot pitches or less.

Paragraph beginning at page 4, line 21 has been amended as follows:

Additionally, for the sealed motor compressor of the present invention, [in addition to the aforementioned respective inventions,] the permanent magnet is a rare earth magnet.

Paragraph beginning at page 4, line 25 has been amended as follows:

Moreover, for the sealed motor compressor of the present invention, [in addition to the aforementioned respective inventions,] the number of permanent magnets embedded in the rotor yoke is an even number.

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Paragraph beginning at page 5, line 2 has been amended as follows:

Furthermore, [in addition to the aforementioned respective inventions,] the sealed motor compressor of the present invention further comprises current-sensitive protection means for detecting a line current.

Paragraph beginning at page 5, line 6 has been amended as follows:

Additionally, for the sealed motor compressor of the present invention[, in addition to the aforementioned respective inventions,] capability control is enabled.

Paragraph beginning at page 7, line 10 has been amended as follows:

An embodiment of the present invention will next be described with reference to the drawings. Fig. 1 is a vertical side sectional view of a sealed motor compressor C to which the present invention is applied. In Fig. 1, in a sealed container 1, a motor (alternating current induction motor) 2 is contained as an electromotive element in an upper part of the container, and a compressing element 3 rotated/driven by the motor 2 is contained in a lower part of the container. The sealed container 1 [is constituted by containing] contains the motor 2 and compressing element 3 beforehand in two pre-divided sections, and hermetically closing the sections by high-frequency welding. Additionally, examples of the sealed motor compressor C include a rotary compressor, reciprocating compressor, and a scroll compressor.

Paragraph beginning at page 7, line 24 has been amended as follows:

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The motor 2 is provided with a single-phase bipolar [constitution] construction, and [constituted of] includes a stator 4 fixed to an inner wall of the sealed container 1, and a rotor 5 supported inside the stator 4 to be freely rotatable centering on a rotation shaft 6. Moreover, the stator 4 is provided with a stator winding 7 for supplying a rotary magnetic field to the rotor 5.

Paragraph beginning at page 9, line 24 has been amended as follows:

Fig. 2 is a plan view of the rotor 5 shown in Fig. 1, and Fig. 3 is a transverse top plan view of the rotor 5. The rotor 5 is [constituted] formed of a rotor yoke 5A, squirrel-cage secondary conductor 5B disposed in a peripheral portion of the rotor yoke 5A, and a permanent magnet 31 embedded in the rotor yoke 5A. A plurality of squirrel-cage secondary conductors 5B are disposed in the peripheral portion of the rotor yoke 5A, and the conductor is injection-molded in a cylindrical hole (not shown) formed in a squirrel-cage shape across an extending direction of the rotation shaft 6 by aluminum die casting. Both ends of the squirrel-cage secondary conductor 5B are formed in a so-called skewed structure such that each end is sloped in a spiral form with a predetermined angle in a circumferential direction of the rotation shaft 6.

Paragraph beginning at page 10, line 12 has been amended as follows:

Moreover, two permanent magnets 31 are embedded in the rotor yoke 5A. The permanent magnets 31 are formed in plate shapes, disposed opposite and parallel to each other centering on the rotor 5, and embedded from one end to the other end of the rotor yoke 5A. Used in the permanent magnet 31 is a rare earth magnet which has a highest magnetic flux density

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among permanent magnets. Opposite surfaces of the permanent magnets 31 are embedded with different magnetic poles. That is to say, the respective permanent magnets 31 are embedded toward the outside of the circumferential direction of the rotor 5 with different magnetic poles, and [constituted] constructed such that a rotating force can be imparted to the rotor 5 with magnetic force lines of a main winding 7A and auxiliary winding 7B described later.

Paragraph beginning at page 11, line 25 has been amended as follows:

Operation of the aforementioned [constitution] construction will next be described. Additionally, it is assumed that the motor 2 is stopped and the startup switch 33A is closed. Moreover, when the power switch (protection switch 34A) is closed, current starts to flow to the main winding 7A and auxiliary winding 7B. Furthermore, [since] because the auxiliary winding 7B is connected to a parallel circuit of the startup capacitor 33 and running capacitor 32, the rotor 5 obtains a required startup torque and starts in a predetermined rotation direction.

Paragraph beginning at page 12, line 8 has been amended as follows:

In this case, [since] because the rotor 5 has a squirrel-cage secondary conductor similar to a general induction machine, the rotor 5 responds to the current flowing to the stator winding 7 and the motor 2 is started. Moreover, when the rotor 5 is accelerated to achieve rotation at a predetermined number of revolutions (in this case, about 80% of the number of synchronous revolutions), the startup switch 33A is opened to disconnect the startup capacitor 33 from the circuit, and the motor 2 is operated only by the running capacitor 32. Thereby, during a transient

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state of the motor 2 from a startup moment at which the power switch closes until the motor enters synchronous running, it is possible to generate a torque larger than a braking torque generated by the permanent magnet 31. Therefore, during self starting, the surpassing large torque is generated and the motor can be started.

Paragraph beginning at page 12, line 24 has been amended as follows:

Moreover, [since] because the squirrel-cage secondary conductor 5B of the rotor 5 is provided with the skewed structure, similarly as the conventional induction motor, self starting can easily be performed with the single phase power source. Moreover, [since] because the synchronous running can be secured by the permanent magnet 31, secondary copper loss during running can largely be decreased.

Paragraph beginning at page 13, line 4 has been amended as follows:

On the other hand, during running of the motor 2, the line current detector 34B monitors the current flowing through the stator winding 7, and it is possible to cut off the power supply to the motor 2 when the rotor 5 generates heat. That is, when the rotor 5 generates heat, the protection means 34 cuts off the current flowing through the stator winding 7, and prevents the rotor 5 from further raising its temperature. This can prevent the permanent magnet 31 embedded in the rotor 5 from being demagnetized by heat (demagnetization by temperature). Additionally, [since] because demagnetization by a predetermined temperature added to the permanent magnet 31 is a conventional known technique, detailed description thereof is omitted.

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Paragraph beginning at page 13, line 17 has been amended as follows:

As described above, [since] because in the rotor 5 of the motor 2 provided with the single-phase bipolar constitution, the permanent magnets 31 are embedded in the squirrel-cage secondary conductor 5B disposed in the peripheral portion of the rotor yoke 5A, and the rotor yoke 5A, the self starting can be performed even in the single-phase bipolar constitution similarly as the conventional induction motor. Additionally, during running, the synchronous running can be secured by the action of the embedded permanent magnet 31, the braking torque generated during the transient state from the starting until the synchronous running raises no problem, and the secondary copper loss during running can largely be reduced.

Paragraph beginning at page 14, line 3 has been amended as follows:

Moreover, [since] because the winding ratio of the main winding 7A to the auxiliary winding 7B by the effecting winding number calculation, a stator winding structure can remain to be the single-phase bipolar structure similarly as the conventional induction motor. This obviates the necessity of additional equipment such as changing of the equipment associated with manufacturing of the stator. Additionally, a running capacitor capacity can be matched to largely improve the running efficiency.

Paragraph beginning at page 14, line 12 has been amended as follows:

Furthermore, [since] because the squirrel-cage secondary conductor 5B is provided with the skewed structure, similarly as the conventional induction motor, it is possible to easily

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perform self starting with the single phase power source. This allows the motor 2 to easily perform the self starting even with the single phase power source. Moreover, [since] because the permanent magnet 31 is formed of a rare earth magnet, it is possible to remarkably increase the magnetic flux density of the permanent magnet 31.

Paragraph beginning at page 14, line 21 has been amended as follows:

Moreover, [since] because two, four, six, or eight permanent magnets 31 are embedded in the rotor yoke 5A, it is possible to set the number of permanent magnets 21 in accordance with a purpose of the motor 2 for use. Furthermore, [since] because the power supply circuit of the stator winding 7 is provided with the current sensitive protection means 34 for detecting the line current, during heating of the rotor 5, the power supply to the motor 2 can be cut off to suppress the temperature rise of the rotor 5. This can prevent the permanent magnet 31 embedded in the rotor 5 from causing the temperature demagnetization by the heat.

IN THE CLAIMS:

Please amend claims 1-13 and 15 as follows:

1. (Amended) A sealed motor compressor comprising, in a sealed container, a compressing element and an electromotive element for driving the compressing element, wherein said electromotive element is fixed to said sealed container and comprises a stator provided with a stator winding and a rotor which rotates in the stator, and

wherein said rotor comprises a squirrel-cage secondary conductor disposed in a peripheral portion of a rotor yoke and a plurality of permanent [magnet] magnets embedded in the rotor yoke.

2. (Amended) The sealed motor compressor according to claim 1, wherein the electromotive element comprises a single-phase bipolar constitution.

3. (Amended) The sealed motor compressor according to claim 2, wherein the electromotive element is started by a system in which a startup capacitor is used.

4. (Twice Amended) The sealed motor compressor according to claim 2, wherein the stator winding comprises a main winding and an auxiliary winding, and a winding ratio of the respective windings by effective winding number calculation is set to be in a range of 1.0 ± 0.5 .

5. (Twice Amended) The sealed motor compressor according to claim 1, wherein the squirrel-cage secondary conductor of the rotor comprises a skewed structure.

6. (Twice Amended) The sealed motor compressor according to claim 1, wherein each of the permanent [magnet] magnets is a rare earth magnet.

7. (Twice Amended) The sealed motor compressor according to claim 1, wherein the number of the permanent magnets embedded in the rotor yoke is any number selected from the group consisting of two, four, six and eight.

8. (Twice Amended) The sealed motor compressor according to claim 1, further comprising current-sensitive protection means for detecting a line current.

9. (Amended) A sealed motor compressor comprising, in a sealed container, a compressing element and an electromotive element for driving the compressing element, said electromotive element being driven by a three-phase power source,

wherein said electromotive element is fixed to said sealed container and comprises a stator provided with a stator winding and a permanent magnet embedded type rotor which rotates in the stator, and

said rotor comprises a squirrel-cage secondary conductor disposed in a peripheral portion of a rotor yoke and a plurality of permanent [magnet] magnets embedded in said rotor yoke.

10. (Amended) The sealed motor compressor according to claim 9, wherein the electromotive element comprises a three-phase bipolar constitution.

11. (Twice Amended) The sealed motor compressor according to claim 9₁ wherein the squirrel-cage secondary conductor of the rotor comprises a skewed structure, and a skew pitch is set to more than 0, and 1.5 slot pitches or less.

12. (Twice Amended) The sealed motor compressor according to claim 9₁ wherein each of the permanent [magnet] magnets is a rare earth magnet.

13. (Twice Amended) The sealed motor compressor according to claim 9₁ wherein the number of the permanent magnets embedded in the rotor yoke is any even number.

15. (Twice Amended) The sealed motor compressor according to claim 9₁ wherein capability control is possible.